Ontario

# Computer Systems Technology Program Standard

***The approved program standard for all Computer Systems Technology programs of instruction leading to an Ontario College Advanced Diploma delivered by Ontario Colleges of Applied Arts and Technology (MTCU funding code 60505)***

**Ministry of Training, Colleges and Universities**
**February 2006**

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Inquiries regarding specific Computer Systems Technology programs offered by colleges of applied arts and technology in Ontario should be directed to the relevant college.

This version replaces the program standard released in August 1998. Inquiries regarding this program standard should be directed to the address noted above.

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# I. Introduction

*This document is the Program Standard for all Computer Systems Technology programs of instruction leading to an Ontario College Advanced Diploma delivered by Ontario colleges of applied arts and technology (MTCU funding code 60505). This version replaces the one released in August 1998.*

## Development of System-Wide Program Standards

In 1993, the Government of Ontario initiated program standards development with the objectives of bringing a greater degree of consistency to college programming offered across the province, broadening the focus of college programs to ensure graduates have the skills to be flexible and to continue to learn and adapt, and providing public accountability for the quality and relevance of college programs.

The Colleges Branch of the Ministry of Training, Colleges and Universities has responsibility for the development, review, and approval of system-wide standards for programs of instruction at Ontario colleges of applied arts and technology.

## Program Standards

Program standards apply to all similar programs of instruction offered by colleges across the province. Each program standard for a postsecondary program includes the following elements:

- **Vocational standard** (the vocationally specific learning outcomes which apply to the program of instruction in question),
- **Essential employability skills** (the essential employability skills learning outcomes which apply to all programs of instruction), and
- **General education requirement** (the requirement for general education in postsecondary programs of instruction).

Collectively, these elements outline the essential skills and knowledge that a student must reliably demonstrate in order to graduate from the program.

Individual colleges of applied arts and technology offering the program of instruction determine the specific program structure, delivery methods, and other curriculum matters to be used in assisting students to achieve the outcomes articulated in the standard. Individual colleges also determine whether additional local learning outcomes will be required to reflect specific local needs and/or interests.

## The Expression of Program Standards as Learning Outcomes

Learning outcomes represent culminating demonstrations of learning and achievement. They are not simply a listing of discrete skills, nor broad statements of knowledge and comprehension. In addition, learning outcomes are interrelated and cannot be viewed in isolation of one another. As such, they should be viewed as a comprehensive whole. They describe performances that demonstrate that significant integrated learning by graduates of the program has been achieved and verified.

Expressing standards as learning outcomes ensures consistency in the outcomes for program graduates, while leaving to the discretion of individual colleges curriculum matters such as the specific program structure and delivery methods.

## The Presentation of the Learning Outcomes

The **learning outcome** statement sets out the culminating demonstration of learning and achievement that the student must reliably demonstrate before graduation.

The **elements of the performance** for each outcome define and clarify the level and quality of performance necessary to meet the requirements of the learning outcome. However, it is the performance of the learning outcome itself on which students are evaluated. The elements are indicators of the means by which the student may proceed to satisfactory performance of the learning outcome. The elements do not stand alone but rather in reference to the learning outcome of which they form a part.

## The Development of a Program Standard

In establishing the standards development initiative, the Government determined that all postsecondary programs of instruction should include vocational skills coupled with a broader set of essential skills. This combination is considered critical to ensuring that college graduates have the skills required to be successful both upon graduation from the college program and throughout their working and personal lives.

A program standard is developed through a broad consultation process involving a range of stakeholders with a direct interest in the program area, including employers, professional associations, universities, secondary schools, and program graduates working in the field, in addition to students, faculty, and administrators at the colleges themselves. It represents a consensus of participating stakeholders on the essential learning that all program graduates should have achieved.

## Updating the Program Standard

The Ministry of Training, Colleges and Universities will undertake regular reviews of the vocational learning outcomes for this program to ensure that the Computer Systems Technology Program Standard remains appropriate and relevant to the needs of students and employers across the Province of Ontario. To confirm that this document is the most up-to-date release, contact the Ministry of Training, Colleges and Universities at the address or telephone number noted on the inside cover page.

# II. Vocational Standard

*All graduates of Computer Systems Technology programs of instruction must have achieved the 13 vocational learning outcomes listed in the following pages, in addition to achieving the essential employability skills learning outcomes and meeting the general education requirement.*

## Preamble

In recent years, computers and their associated technologies have become vital tools in today's business and personal environments. Increasingly, individuals and organizations look to computers networks and decentralized knowledge bases, be they stand-alone or networked, to optimize workflow, establish a presence in global markets, improve communication, and just generally maximize return on investment. This pervasive integration of computers and their associated technologies has led to an emergence of job opportunities in the creation, integration, and support of information technology systems and infrastructures.

Ontario colleges of applied arts and technology offer a wide variety of information technology programs that prepare graduates for both existing and emerging opportunities in our society. At the heart of the information technology education provided to Ontario college students is the ability to think critically, solve problems, and acquire new skills quickly. While these abilities are practised and enhanced in the context of a particular expertise, they are also transportable, with a reasonable training period, to other areas of expertise involving computers and their associated technologies.

Graduates of Computer Systems Technology Programs have honed their abilities, acquiring the expertise to support the use of computers and networks in many facets of our daily lives. As such, graduates are able to work individually or as part of a team to design and implement information technology solutions that correspond to the day-to-day requirements of individuals and organizations. From monitoring network operations to assessing security solutions, graduates work in a broad range of employment settings in a variety of sectors in both large and small organizations.

While the vocational learning outcomes for programs, such as Computer Systems Technology, articulate the depth and breadth of skills, knowledge, and attitudes required by graduates when entering the work force, individual college programs may choose to build on this standard by offering some degree of specialization. Irrespective of the specialization, graduates' learning is significantly enhanced by opportunities for as much practical experience as is feasible during their time in the program.

There are many opportunities for graduates to pursue further educational qualifications; graduates may be granted credits towards a degree or certification through articulation agreements between the colleges and universities. Students should contact individual colleges for further details of a college's articulation agreements.

To be successful in an information technology environment requires an ongoing commitment from the graduate to continue to update his/her skills to stay current in this rapidly changing field. Making use of knowledge and experience gained during their studies, graduates may also choose to apply for professional designations from provincial, national, and international organizations as a further demonstration of their commitment to keep their skills current.

# Synopsis of the Vocational Learning Outcomes
# Computer Systems Technology Programs

*The graduate has reliably demonstrated the ability to*

1. **analyze and resolve information technology problems through the application of systematic approaches and diagnostic tools.**

2. **analyze, plan, design, and implement computer systems.**

3. **analyze, plan, design, and implement networking solutions.**

4. **install, configure, troubleshoot, monitor, maintain, upgrade, and optimize computer systems.**

5. **install, configure, troubleshoot, monitor, maintain, upgrade, and optimize networks.**

6. **use a variety of scripting tools and languages to automate routine tasks.**

7. **participate in the deployment and administration of databases within a networked environment.**

8. **plan, develop, and be responsible for data storage to ensure the integrity of information.**

9. **apply knowledge of security issues to the implementation of information technology solutions.**

10. **appraise existing security solutions with a view to on-going maintenance, development, and improvement of organizational security.**

11. **provide efficient and effective technical support to clients in a manner that promotes safe computing practices and reduces the risk of the issue recurring.**

12. **articulate, defend, and conform to workplace expectations found in information technology (IT) environments.**

13. **contribute to the successful completion of the project applying the project management principles in use.**

Note: The learning outcomes have been numbered as a point of reference; numbering does not imply prioritization, sequencing, nor weighting of significance.

# The Vocational Learning Outcomes

1. *The graduate has reliably demonstrated the ability to*

   **analyze and resolve information technology problems through the application of systematic approaches and diagnostic tools.**

**Elements of the Performance**

- Analyze information technology problems and formulate solutions (e.g., hardware, software, operating systems, communications, process-related)
- Implement a variety of systematic troubleshooting methodologies
- Use a variety of troubleshooting tools
- Research and determine an appropriate course of action
- Develop and follow appropriate procedures and methodologies to resolve problems effectively and minimize risk of recurrence
- Monitor, review, and assess the effectiveness of the solution
- Document the problem and solution and communicate results with others
- Minimize risk to client
- Implement solution in a timely and low-impact fashion

2. *The graduate has reliably demonstrated the ability to*

**analyze, plan, design, and implement computer systems.**

**Elements of the Performance**

- Develop and execute plans for gathering data
- Use a variety of techniques for gathering data (e.g., research, interviewing)
- Conduct a needs assessment and determine requirements for computer systems
- Design and implement computer systems to meet user requirements
- Apply knowledge of a variety of architectures to integrate the components of computer systems
- Apply knowledge of a variety of hardware platforms and operating systems
- Select and use appropriate tools and techniques to monitor, test, validate, and evaluate the effectiveness of a system
- Design and execute a test plan
- Identify stakeholders impacted by a new system
- Produce, present, and maintain clear, accurate, systems- and project-related documents, including detailed diagrams

3. *The graduate has reliably demonstrated the ability to*

**analyze, plan, design, and implement networking solutions.**

**Elements of the Performance**

- Develop and execute plans for gathering data
- Use a variety of tools and techniques for gathering data (e.g., research, interviewing)
- Conduct a needs assessment and determine requirements for networking solutions
- Design and implement a network to meet user requirements
- Apply knowledge of computer connectivity, networks, and telecommunications (e.g., Internet, Intranet, local area networks, wide area networks, wireless devices, Voice Over IP)
- Apply knowledge of a variety of hardware platforms and operating systems to the implementation of networking solutions
- Select and use appropriate tools and techniques to monitor, test, validate, and evaluate the effectiveness of a networking solution
- Design and execute a test plan
- Identify stakeholders impacted by a new networking solution
- Produce, present, and maintain clear, accurate, network- and project-related documents, including detailed diagrams
- Consider security issues while designing networking solutions

4. *The graduate has reliably demonstrated the ability to*

**install, configure, troubleshoot, monitor, maintain, upgrade, and optimize computer systems.**

**Elements of the Performance**

- Apply knowledge of a variety of computer components to resolve technical problems
- Upgrade and optimize computer systems to adapt to the changing technological and organizational environment
- Install and configure a variety of client and server software applications
- Assess, select, and use standard tools, techniques, and equipment to install and troubleshoot computer systems
- Acquire and use relevant technical information from a variety of sources (e.g., technical manuals, online support, help desks)
- Document the system baseline performance and verify performance when hardware or software is added
- Develop preventive maintenance schedules

5. *The graduate has reliably demonstrated the ability to*

**install, configure, troubleshoot, monitor, maintain, upgrade, and optimize networks.**

**Elements of the Performance**

- Apply knowledge of a variety of network components and network management services to resolve technical problems
- Upgrade and optimize networks to adapt to the changing technological and organizational environment
- Install and configure a variety of client and server remote-access software applications
- Select and use standard tools, techniques, and equipment to install and troubleshoot networks
- Acquire and use relevant technical information from a variety of sources (e.g., technical manuals, online support, help desks)
- Consider the security implications of integrating information technology into global networks
- Identify the bottleneck in the network and optimize performance

6. *The graduate has reliably demonstrated the ability to*

**use a variety of scripting tools and languages to automate routine tasks.**

**Elements of the Performance**

- Apply basic knowledge of relevant scripting tools and techniques
- Use a variety of strategies to resolve routine scripting problems
- Apply basic knowledge of a variety of scripting languages
- Apply knowledge of new and current development tools
- Assess, select, and use appropriate tools and techniques to develop and maintain administrative scripts and task automation
- Provide clear and accurate comments on the script
- Apply knowledge of automation tools to deploy and migrate software applications and user configurations

7. *The graduate has reliably demonstrated the ability to*

**participate in the deployment and administration of databases within a networked environment.**

**Elements of the Performance**

- Identify potential impediments to the deployment of databases in a networked environment
- Assess potential connectivity and security risks in the deployment and administration of a database
- Apply knowledge of the installation requirements for common database packages
- Apply knowledge of query languages
- Schedule back-ups of database
- Complete routine administration tasks
- Grant access to a networked database
- Restore users, where required

8. *The graduate has reliably demonstrated the ability to*

**plan, develop, and be responsible for data storage to ensure the integrity of information.**

**Elements of the Performance**

- Maintain infrastructure to capture, store, and update information
- Plan and maintain data storage and retrieval systems
- Develop strategies for backup and recovery of information
- Apply information security protocols and procedures
- Plan and develop schedules for archiving of data
- Recover user data from storage back-up
- Research and select appropriate equipment
- Participate in the organization's planning for incident response and disaster recovery
- Follow established procedures for incident response and disaster recovery, should the need arise

9. *The graduate has reliably demonstrated the ability to*

**apply knowledge of security issues to the implementation of information technology solutions.**

**Elements of the Performance**

- Apply knowledge of software and hardware firewalls
- Apply knowledge of anti-virus and anti-spamming software
- Seek out and remove malicious software (e.g., viruses, worms, trojan horses, spyware, ad-ware) that affects the reliability of IT resources
- Monitor host behaviour and network activity with a view to ensuring a secure environment
- Conduct security updates minimizing client downtime
- Recognize the role of physical security in the implementation of information technology solutions
- Follow procedures and policies for keeping security software up-to-date
- Apply knowledge of network services (e.g., e-mail, shares, Voice Over IP) to minimize security threats to the organization
- Assess security risks created through the implementation of new information technology solutions
- Manage sensitive information held by the organization according to its assigned classification
- Apply knowledge of intrusion detection and prevention to networking environments
- Assist in evaluating and enforcing security-related policies and documents
- Apply knowledge of remote-access and wireless technologies to allow secure remote access to the network and its resources

10. *The graduate has reliably demonstrated the ability to*

**appraise existing security solutions with a view to on-going maintenance, development, and improvement of organizational security.**

**Elements of the Performance**

- Identify existing network and information security protocols and procedures in place
- Recognize the role of physical security in the development of organizational security
- Identify security risks and evaluate the level of the risks
- Propose alternative security solutions, where appropriate
- Assess potential security risks created by changes within an established and secure environment
- Function within the boundaries of established organizational policy, as well as legal and legislative requirements
- Contribute to the development of organizational policy pertaining to network and information security
- Take into account potential disruptions to clients workflow when recommending improvements to organizational security
- Recommend security practices for dealing with sensitive information

11. *The graduate has reliably demonstrated the ability to*

**provide efficient and effective technical support to clients in a manner that promotes safe computing practices and reduces the risk of the issue recurring.**

**Elements of the Performance**

- Promote an environment of effective communication
- Respond to client inquiries promptly
- Maintain professional and honest relationships with clients
- Apply knowledge of proper client service to the maintenance of client relationship
- Work to ensure satisfactory realization of client's expectations
- Recognize personal limits and seek assistance in a timely manner to resolve problems beyond own knowledge and skills
- Incorporate practical education of clients in the resolution of the issue
- Support the sales function
- Field calls and inquiries
- Identify relevant issues in reported information
- Express problem and solution in non-technical language
- Solicit information from clients respectfully and tactfully
- Use judgement to balance organizational policies and procedures regarding technical support and the level of client knowledge
- Educate client on alternative and reliable sources of support information (e.g., FAQs, knowledge bases, online support) should the issue recur
- Report and document incidents breaching service-level agreements (e.g., 24/7 support, 99.999% uptime)
- Document, with appropriate level of detail, each instance of customer support
- Maintain appropriate case-by-case documentation of the solution applied

12. *The graduate has reliably demonstrated the ability to*

**articulate, defend, and conform to workplace expectations found in information technology (IT) environments.**

**Elements of the Performance**

- Recognize personal limits and seek assistance in a timely manner to resolve problems beyond own knowledge and skills
- Use language and terminology suited to the context
- Keep abreast of relevant technological change
- Adhere to and advocate ethical principles and standards
- Follow organizational policies and procedures and facilitate the communication of updates
- Use appropriate communication etiquette when using electronic technology
- Identify guidelines set by appropriate organizations and bodies that prescribe quality programs, practices, processes, and procedures which apply to information technology environments
- Ensure quality of assigned work
- Comply with software licensing requirements
- Make appropriate use of IT resources in the workplace
- Adhere to and advocate safe computing practices
- Participate in workplace mentoring programs
- Apply knowledge of existing confidentiality, privacy, and reporting regulations to daily work
- Function within the boundaries of established organizational policy, as well as legal and legislative requirements

13. *The graduate has reliably demonstrated the ability to*

**contribute to the successful completion of the project applying the project management principles in use.**

**Elements of the Performance**

- Participate in the planning, identification, scheduling, and assigning of tasks and resources involved in a project as required
- Contribute to the monitoring of resources and expenditures to maintain cost effectiveness and timelines as required
- Consolidate project updates regularly
- Estimate accurately the time required to complete project elements
- Complete project elements according to schedule
- Interpret and use project planning documents (e.g., Gantt Charts, Critical Path Analysis Charts, PERT Charts)
- Identify problems that will affect the project timeline and recommend changes as soon as possible
- Maintain current, clear, and accurate project-related documents which adhere to organizational and industry standards and procedures
- Use project management software

# III. Essential Employability Skills

*All graduates of Computer Systems Technology programs of instruction must have reliably demonstrated the essential employability skills learning outcomes listed on the following pages, in addition to achieving the vocational learning outcomes and meeting the general education requirement.*

## Context

Essential Employability Skills (EES) are skills that, regardless of a student's program or discipline, are critical for success in the workplace, in day-to-day living, and for lifelong learning.

The teaching and attainment of these EES for students in, and graduates from, Ontario's colleges of applied arts and technology are anchored in a set of three fundamental assumptions:

- These skills are important for every adult to function successfully in society today.
- Our colleges are well equipped and well positioned to prepare graduates with these skills.
- These skills are equally valuable for all graduates, regardless of the level of their credential, whether they pursue a career path, or they pursue further education.

## Skill Categories

To capture these skills, the following six categories define the essential areas where graduates must demonstrate skills and knowledge.

- Communication
- Numeracy
- Critical Thinking & Problem Solving
- Information Management
- Interpersonal
- Personal

## Application / Implementation

In each of the six skill categories, there are a number of defining skills, or sub skills, identified to further articulate the requisite skills identified in the main skill categories. The following chart illustrates the relationship between the skill categories, the defining skills within the categories, and learning outcomes to be achieved by graduates from all postsecondary programs of instruction that lead to an Ontario College credential.

EES may be embedded in General Education or vocational courses, or developed through discrete courses. However these skills are developed, all graduates with Ontario College credentials must be able to reliably demonstrate the essential skills required in each of the six categories.

| **SKILL CATEGORY** | **DEFINING SKILLS: Skill areas to be demonstrated by graduates:** | **LEARNING OUTCOMES: The levels of achievement required by graduates. The graduate has reliably demonstrated the ability to:** |
|---|---|---|
| COMMUNICATION | • Reading<br>• Writing<br>• Speaking<br>• Listening<br>• Presenting<br>• Visual literacy | 1. *communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.*<br>2. *respond to written, spoken, or visual messages in a manner that ensures effective communication.* |
| NUMERACY | • Understanding and applying mathematical concepts and reasoning<br>• Analyzing and using numerical data<br>• Conceptualizing | 3. *execute mathematical operations accurately.* |
| CRITICAL THINKING & PROBLEM SOLVING | • Analysing<br>• Synthesising<br>• Evaluating<br>• Decision making<br>• Creative and innovative thinking | 4. *apply a systematic approach to solve problems.*<br>5. *use a variety of thinking skills to anticipate and solve problems.* |
| INFORMATION MANAGEMENT | • Gathering and managing information<br>• Selecting and using appropriate tools and technology for a task or a project<br>• Computer literacy<br>• Internet skills | 6. *locate, select, organize, and document information using appropriate technology and information systems.*<br>7. *analyze, evaluate, and apply relevant information from a variety of sources.* |

| SKILL CATEGORY | DEFINING SKILLS: Skill areas to be demonstrated by graduates: | LEARNING OUTCOMES: The levels of achievement required by graduates. The graduate has reliably demonstrated the ability to: |
|---|---|---|
| INTERPERSONAL | • Team work<br>• Relationship management<br>• Conflict resolution<br>• Leadership<br>• Networking | 8. *show respect for the diverse opinions, values, belief systems, and contributions of others.*<br>9. *interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals.* |
| PERSONAL | • Managing self<br>• Managing change and being flexible and adaptable<br>• Engaging in reflective practices<br>• Demonstrating personal responsibility | 10. *manage the use of time and other resources to complete projects.*<br>11. *take responsibility for one's own actions, decisions, and consequences.* |

# IV. General Education Requirement

*All graduates of Computer Systems Technology programs must have met the general education requirement described on the following pages, in addition to achieving the vocational and essential employability skills learning outcomes.*

## Requirement

The General Education Requirement for programs of instruction is stipulated in the Credentials Framework (Appendix A in the Minister's Binding Policy Directive *Framework for Programs of Instruction*).

While the inclusion of General Education is locally determined for programs of instruction leading to either a college certificate or an Ontario College Certificate, it is recommended that graduates of the Ontario College Certificate programs have been engaged in learning that incorporates some breadth beyond the vocational field of study.

In programs of instruction leading to either an Ontario College Diploma or an Ontario College Advanced Diploma, it is required that graduates have been engaged in learning that exposes them to at least one discipline outside their main field of study, and increases their awareness of the society and culture in which they live and work. This will typically be accomplished by students taking 3 to 5 courses (or the equivalent) designed discretely and separately from vocational learning opportunities.

This general education learning would normally be delivered using a combination of required and elective processes.

## Purpose

The purpose of General Education in the Ontario college system is to contribute to the development of citizens who are conscious of the diversity, complexity, and richness of the human experience; who are able to establish meaning through this consciousness; and, who, as a result, are able to contribute thoughtfully, creatively, and positively to the society in which they live and work.

General Education strengthens student's essential employability skills, such as critical analysis, problem solving, and communication, in the context of an exploration of topics with broad-based personal and / or societal importance.

## Themes

The themes listed below will be used to provide direction to colleges in the development and identification of courses that are designed to fulfil the General Education Requirement for programs of instructions.

Each theme provides a statement of Rationale and offers suggestions related to more specific topic areas that could be explored within each area. These suggestions are neither prescriptive nor exhaustive. They are included to provide guidance regarding the nature and scope of content that would be judged as meeting the intent and overall goals of General Education.

### 1. Arts in Society:

*Rationale:*
The capacity of a person to recognize and evaluate artistic and creative achievements is useful in many aspects of his/her life. Since artistic expression is a fundamentally human activity, which both reflects and anticipates developments in the larger culture, its study will enhance the student's cultural and self-awareness.

*Content:*
Courses in this area should provide students with an understanding of the importance of visual and creative arts in human affairs, of the artist's and writer's perceptions of the world and the means by which those perceptions are translated into the language of literature and artistic expression. They will also provide an appreciation of the aesthetic values used in examining works of art and possibly, a direct experience in expressing perceptions in an artistic medium.

### 2. Civic Life:

*Rationale:*
In order for individuals to live responsibly and to reach their potential as individuals and as citizens of society, they need to understand the patterns of human relationships that underlie the orderly interactions of a society's various structural units. Informed people will have knowledge of the meaning of civic life in relation to diverse communities at the local, national, and global level, and an awareness of international issues and the effects of these on Canada, and Canada's place in the international community.

*Content:*
Courses in this area should provide students with an understanding of the meaning of freedoms, rights, and participation in community and public life, in addition to a working knowledge of the structure and function of various levels of government (municipal, provincial, national) in Canada and/or in an international context. They may also provide an historical understanding of major political issues affecting relations between the various levels of government in Canada and their constituents.

### 3. Social and Cultural Understanding:

*Rationale:*
Knowledge of the patterns and precedents of the past provide the means for a person to gain an awareness of his or her place in contemporary culture and society. In addition to this awareness, students will acquire a sense of the main currents of their culture and that of other cultures over an extended period of time in order to link personal history to the broader study of culture.

*Content:*
Courses in this area are those that deal broadly with major social and cultural themes. These courses may also stress the nature and validity of historical evidence and the variety of historical interpretation of events. Courses will provide the students with a view and understanding of the impact of cultural, social, ethnic, or linguistic characteristics.

### 4. Personal Understanding:

*Rationale:*
Educated people are equipped for life-long understanding and development of themselves as integrated physiological and psychological entities. They are aware of the ideal need to be fully functioning persons: mentally, physically, emotionally, socially, spiritually, and vocationally.

*Content:*
Courses in this area will focus on understanding the individual: his or her evolution; situation; relationship with others; place in the environment and universe; achievements and problems; and his or her meaning and purpose. They will also allow students the opportunity to study institutionalized human social behaviour in a systematic way. Courses fulfilling this requirement may be oriented to the study of the individual within a variety of contexts.

### 5. Science and Technology:

*Rationale:*
Matter and energy are universal concepts in science, forming a basis for understanding the interactions that occur in living and non-living systems in our universe. Study in this area provides an understanding of the behaviour of matter that provides a foundation for further scientific study and the creation of broader understanding about natural phenomena.

Similarly, the various applications and developments in the area of technology have an increasing impact on all aspects of human endeavour and have numerous social, economic, and philosophical implications. For example, the operation of computers to process data at high speed has invoked an interaction between machines and the human mind that is unique in human history. This development and other technological developments have a powerful impact on how we deal with many of the complex questions in our society.

*Content:*
Courses in this area should stress scientific inquiry and deal with basic or fundamental questions of science rather than applied ones. They may be formulated from traditional basic courses in such areas of study as biology, chemistry, physics, astronomy, geology, or agriculture. As well, courses related to understanding the role and functions of computers (e.g., data management and information processing), and assorted computer-related technologies, should be offered in a non-applied manner to provide students with an opportunity to explore the impact of these concepts and practices on their lives.